Portfolio-based tests of the costs of rapid firm-level internationalisation

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Abstract

Using a longitudinal dataset of almost 430,000 observations on the degree of internationalisation and stock market performance of 396 *Russell 1000* firms between 1996 and 2010, we conduct portfolio-based tests of how the *level* and *speed* of firm-level internationalisation relates to firm-level performance. We find that the most consistently international firms with the greatest global reach tend to reliably outperform firms that are not internationalised. Rapidly internationalising firms under-perform relative to these highly-internationalised firms, suggesting that the costs of rapid firm-level internationalisation are substantial. Our methodology contributes to the literature on testing alternative theories of firm-level internationalisation, and our findings contribute to the international diversification and home bias literatures. By investing in home-based firms that are highly internationalised while avoiding or short-selling home-based firms that are rapidly internationalising, investors can reap the most substantial benefits from international diversification without incurring the costs and risks of investing overseas.

Keywords

MNCs, international diversification, home bias puzzle.

JEL Classification

F21, F23, G11, G15

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1. Introduction

Enhanced integration throughout the world's commodity, manufacturing and service sectors has expanded the opportunities for firms and investors to obtain the synergistic gains from trade. Firms have responded by internationalising their activities across greater distances through trading, alliances, licensing, joint venturing and foreign direct investment. As they internationalise, they have to make decisions about the range of geographical, cultural and psychic distances of their planned operations from their home base, the kinds of contractual arrangements they envisage entering into, and the speed with which they plan to proceed. The many alternative types and levels of engagement are associated with varying costs, expected returns, risks and degrees of operational control. Given their objectives, their internal resources, and the external opportunities and constraints they face, internationalising firms choose the pathways they believe will maximise their risk-adjusted returns net of expected costs.

The three most prominent theories of the firm-level internationalisation process are the ownership-location-internalisation (OLI) eclectic paradigm (Dunning 1977; 2000)[1]; the Uppsala internationalisation process theory (IPT) (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1990, 2013[2]); and the new venture internationalisation theory (NVIT) theory (McDougall, Shane and Oviatt, 1994; Barkema and Vermuelen, 1997; and Oviatt and McDougall, 1997)[3]. These theories have been discussed and evaluated by many scholars (Andersen, 1997; Coviello and McAuley, 1999; Jones, 1999; Hutzschenreuter, Pederson and Volberda, 2007; and Aggerwal et al, 2011). While the OLI eclectic paradigm focuses on discrete rational decision-making and the Uppsala IPT model emphasises organisational learning, both imply that the internationalisation process will be a sequential one, in which firms internationalise in stages as their OLI advantages increase over time, or as they gain more knowledge, experience and confidence according to the Uppsala model. By way of contrast, the NVIT suggests that the internationalisation process can be very fast, particularly for younger firms in technology-intensive industries where growing numbers of 'born global' firms can be found (Melén & Nordman, 2009; Hagen & Zucchella, 2014).

In the rich ecology of today's business landscape that is populated by firms of different age, size, industry and country of origin, we should expect to observe great variety in the patterns of

internationalisation at the level of the firm, and it is unlikely that any one theory will encompass the diversity of internationalisation pathways. In this vein, Jones and Coviello (2005) have combined the insights from the OLI paradigm, the Uppsala model and NVIT to suggest how integrating their theoretical perspectives on firm-level characteristics and behaviours can yield a more complete understanding of the internationalisation process. Hutzschenreuter, Pederson and Volberda (2007) have further observed that key determinants of the processes within the eclectic OLI paradigm and the Uppsala model can yield path-dependent patterns of internationalisation that are incremental in nature, largely peripheral to managerial initiatives and strategies, and different for each firm with limited potential for generic typology.

In moving from the theory of firm-level internationalisation to observing what happens in practice, a substantial empirical literature seeks to answer key questions about the process. Two key questions of relevance to our paper are whether firms create value by internationalisation, and whether investors can gain access to some proportion of this value by investing in internationalised firms. On the first question, researchers initially sought evidence on a positive linear relation between the degree of internationalisation and firm performance, but mixed results led to the investigation of various nonlinear relations, such as quadratic, U-shaped and horizontal S-shaped. Douglas and Craig (1983), Lecraw (1983), Grant (1987) and Brouthers,Werner and Matulich (2000) have found that the degree of firm-level internationalisation is associated with rising profitability. In contrast, Mishra and Gobeli (1998) have found that greater internationality per se does not deliver greater value; Gomes and Ramaswamy (1999) have reported that it brings performance benefits up to a point beyond which they cease; and Kotabe, Srinivasan and Aulakh (2002) report that the benefits of firm-level internationalisation are moderated by R&D and marketing capabilities. On the second question, some studies conclude that investing in internationalised firms provides significant diversification benefits to investors (Hughes, Logue, & Sweeney, 1975; Agmon & Lessard, 1977; Michel & Shaked, 1986; Qian, 1996; Rowland & Tesar, 2004; Berrill & Kearney, 2010), but others find little or no benefit (Jacquillat & Solnik, 1978; Mikhail & Shawky, 1979; Omer, Durr, Siegel, & Khursheed, 1998; Salehizadeh, 2003).

In this paper, we show how the methodologies and insights from portfolio theory can provide a powerful lens through which we can focus on important aspects of the firm-level internationalisation process. Whether internationalising firms advance along pathways as described by one or more of the prevailing theories, or whether they follow other routes that are not encompassed by mainstream theory, we know that each firm chooses its own idiosyncratic route that it believes will maximise its risk-adjusted returns net of expected costs. By studying firms that are publicly listed and regularly traded on organised exchanges, we can directly observe the market's assessment, based on all available information, of each firm's risk-adjusted returns net of expected costs (see, *inter alia*, Chan, 2003; Fang and Peress, 2009; Carretta et al 2011 ; Dougal et al, 2012). By training our portfolio lens on a substantial longitudinal dataset of firms at various stages along their internationalisation paths, we can directly observe and trace each firm's journey as it unfolds over time. We can form groups of firms at different phases along their journeys, and groups that are internationalising at different speeds. Thus we can form portfolios of purely domestic firms that operate entirely within their home country with no plans to internationalise; firms at the early stages of internationalisation that are advancing cautiously at slow pace; firms that are substantially internationalised and advancing rapidly; and firms that are already and sustainably global in their operations, strategies and vision.

We implement our tests by constructing a longitudinal dataset of almost 430,000 observations on the degree of internationalisation and stock market performance of 396 *Russell 1,000* firms over the period 1996 to 2010. We obtain annual measures of the *extent* of firm-level internationalisation using three alternative metrics and various combinations of them: the percentage of foreign to total sales, the number of regions in which foreign sales are located using Aggarwal's et al (2010) division of the world into six regions, and the number of geographic segments included in IFRS8 reports. Our longitudinal dataset allows us to measure how the *extent* of each firm's internationalisation evolves over time, and this captures the *speed* dimension. We obtain our sales data from *Worldscope*, and weekly firm performance data from *Datastream*. Having constructed our portfolios of firms that are internationalised to varying degrees and at various speeds, use mean-variance spanning and Sharpe ratios to test the diversification benefits of firms with the greatest and least change in each measure of internationalisation[4]. We find that the most consistently international firms with the greatest

global reach tend to reliably outperform firms that are not internationalised. We also find that rapidly internationalising firms tend to significantly under-perform relative to these highly-internationalised firms, suggesting that the costs of rapid firm-level internationalisation are substantial and might initially outweigh the benefits.

Our paper has important implications for understanding the so-called 'international diversification' or 'home bias' puzzle. This arises because although the benefits of international portfolio diversification are significant, and although the costs and risks associated with achieving them appear small relative to those associated with internationalising at the level of the firm, investors continue to hold the majority of their equity portfolios in domestic rather than foreign-based firms. The home bias literature offers a number of explanations for this phenomenon, including currency and political risk, information asymmetries, transaction costs, taxes, legal restrictions and other controls (Tesar & Werner, 1995; Baxter & Jermann, 1997; Hasan and Simaan, 2000; Aherne, Griever, and Warnock, 2004; Fidora, Fratzscher, and Thimann, 2007). Overall, however, it is widely agreed that home bias continues to exist despite the well-understood benefits of international diversification, and that it results from investor preferences as much as from market imperfections (Lewis, 1999; Wei, 2000; Karolyi & Stulz, 2002; Portes & Rey, 2005; Aurelio, 2006; French, 2008; Berrill & Kearney, 2010). Our results contribute to this literature by showing that investing in home-based firms that are highly internationalised, while avoiding or short-selling home-based firms that are rapidly internationalising, enables investors to reap the most substantial benefits from international diversification without incurring the costs and risks of investing overseas.

The remainder of this paper is structured as follows. In Section 2 we describe our data. In section 3, we set out the methodology we use to measure diversification benefits. In Section 4 we present our findings and in Section 5 we summarize our research, draw together our conclusions and make suggestions for future work.

2. Data and Methodology

A number of systems have been proposed to classify the degree of firm-level internationalisation (Perlmutter, 1969; Bartlett & Ghoshal, 1989; Sullivan, 1994; Rugman & Verbeke, 2004; and Aggarwal et al, 2010). Casillas & Acedo (2013) observe that firm-level internationalisation can be measured along the three dimensions of *extent*, *scope* and *speed*. They show how most studies focus on the *extent* of internationalisation, typically measured by the percentage of foreign to total sales, and they further observe a dearth of studies that consider changes in either the *extent* or *scope*. In this paper, we focus on the *extent* and *speed* dimensions. We measure the *extent* of firm-level internationalisation by three metrics: the percentage of foreign to total sales, the number of regions in which foreign sales are located, and the number of geographic segments reported by the firm. Our longitudinal dataset allows us to measure how the *extent* evolves over time, and this captures the *speed* dimension.

A firm's foreign sales as a percentage of its total sales is the most commonly used method to select firms to test for diversification benefits and is a reliable quantitative measure of foreign involvement. However, it makes no distinction between a firm with a high percentage of foreign sales spread across many countries or in a neighbouring country. For example, in 2010, Applied Materials has 69 percent foreign sales spread across Taiwan, South Korea, China, Europe, Japan and other Asia Pacific, while in 1996 Forest Oil has 74 percent foreign sales, but all occur in Canada. Counting the number of geographic segments in which a firm reports material foreign sales provides useful information on the dispersion of a firm's sales and overcomes some of the limitations of using percentage foreign sales as a measure of internationalisation.[5] However, in some cases it can be misleading, given that a firm can choose to specify a single country or an entire continent as one of its segments. For example, in 2010 Gilead Sciences, a biotech company from California, lists eight geographical segments; United States, France, Switzerland, Spain, United Kingdom, Italy, Germany, Other Europe. In contrast Avnet, a technology company from Arizona, lists just three; Americas, EMEA, and Asia Pacific, despite covering a much greater geographic area. Finally, we count the number of regions of the world in which the firm's reported geographic segments are located. We categorise firms by the number of regions in which their sales occur as follows. Following Aggarwal et al. (2011) we divide the world into six regions: Africa, Asia, Europe, North America, Oceania and South America. If a firm has no

foreign sales it is given a score of 0, if it has sales outside of the US but only in North America, it is given a number of score of 1, if it has sales in North America plus one other region it receives a score of 2 and so on until a maximum score of 6, which indicates that a firm has sales in every region.[6]

Data

We select firms from the 2011 constituent list of the Russell 1000, a market value weighted index that represents approximately 92 per cent of the US market. For each firm we obtain its foreign sales as a percentage of total sales for each year from 1996 to 2010. We obtain the geographical breakdown of each firm's sales for every year over the same period. Firms may specify up to ten geographic segments in which material sales occur.[7] Firms with incomplete data for either percentage foreign sales or the geographic breakdown of sales are excluded. We use weekly closing prices from 1996 to 2010 for the return index (RI) calculated by Datastream to represent the total return including dividends for each firm. For the risk free rate we use the weekly 3 month T-Bill rate. Full data is available for 396 firms. Table 1 describes all variables used in our study along with their source.

Longitudinal analysis of firm-level internationalisation

Our longitudinal dataset allows us to examine patters of firm internationalisation over time. We categorise firms by each measure of internationalisation in each year, we identify firms with the greatest and least changes in each measure of internationalisation, and we compare our three measures. We chart the internationalisation pattern of three individual firms to illustrate the how individual firms internationalise. We calculate the correlation of internationalised firms with firms with no foreign exposure and their risk-adjusted returns.

We form portfolios of firms; the fastest internationalisers and the most consistently international firms. We refer to portfolios of firms whose level of internationalisation has increased the most between 1996 and 2010 as Type 1 portfolios and to portfolios of firms with the consistently highest levels of internationalisation in every year as Type 2 portfolios. We create equally weighted Type 1 and Type 2 portfolios, as well as a portfolio of domestic firms with no foreign activity in any year. All previous studies that test the diversification benefits of portfolios of MNCs use either value-weighted portfolios (Shaked, 1986; Cai & Warnock, 2004; Berrill &

Kearney, 2010) or equally-weighted portfolios (Mikhail & Shawky, 1979; Fatemi, 1984; Michel & Shaked, 1986; Omer et al., 1998; Salehizadeh, 2003; Filat & Garetto, 2012). Optimally-weighted portfolios have been used in studies of international diversification benefits (Eun & Resnick, 1994; Christoffersen et al., 2012) and the diversification benefits of exchange-traded funds, iShares and CCFs (Miffre, 2007; Huang & Lin, 2011). Optimal weights calculate the maximum attainable Sharpe ratio of a portfolio but these weights can only be known ex-post. Equally-weighted or value-weighted portfolios represent a more realistic scenario. Optimal weights may allow or disallow short selling. As many portfolio managers are restricted to being only long assets, optimal weights with no short sales calculates the maximum Sharpe ratio possible in this scenario. In addition to equally weighted portfolios, we create optimally weighted portfolios where the weight of each MNC in the portfolio is optimised with and without short sales. We use Mean-Variance Spanning and Sharpe ratios to test for diversification benefits.

3. Testing methodology

Mean-variance spanning tests whether the inclusion of additional assets shifts the efficient frontier of a portfolio. This methodology is first documented by Huberman & Kandel (1987), its geometric interpretation has been provided by Kan & Zhou (2012), and the interpretation in our context using Wald tests is provided in Figure 1. It is used by Driessen & Laeven (2007) to investigate the benefits of international diversification across different countries. It is also used by Bekaert & Urias, (1996), Errunza, Hogan and Hung (1999), DeRoon & Nijman (2001), Rowland and Tesar (2004) and Berrill and Kearney (2010) in studies of home based international diversification. Mean variance spanning tests consider a set of K benchmark assets and N test assets and tests whether the K benchmark assets span the extended set of K+N assets. That is, whether the addition of the N test assets shifts the mean-variance efficient frontier of the K benchmark assets. We begin by defining $R_{1,t}$ as the K×1 vector of returns on the K benchmark assets at time t, we define $R_{2,t}$ as the N×1 returns on the N test assets at time t, and we combine $R_{1,t}$ and $R_{2,t}$ in the K+N vector $R_t = [R_{1,t}^{'}, R_{2,t}^{'}]^{'}$. The expected returns $E[R_t]$ and the variances $Var[R_t]$ on these K+N assets can be written as

$$E[R_t] = \mu = \begin{vmatrix} \mu_1 \\ \mu_2 \end{vmatrix} \qquad Var[R_t] = V = \begin{vmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{vmatrix} \tag{1}$$

The mean variance spanning test proceeds by estimating the following model using OLS, which regresses the N test asset returns on the K benchmark asset returns,

$$R_{2,t} = \alpha + \beta R_{1,t} + \varepsilon_t \tag{2}$$

with $\varepsilon_t \sim N(0, \Sigma)$, $a = E[R_{2,t}] - \beta E[R_{1,t}] = \mu_2 - \beta\mu_1$ and $\beta = V_{21}V_{11}^{-1}$.

By defining $\delta = 1_N - \beta 1_K$, we can see that in order to test whether the set of K benchmark assets spans the broader set of K+N assets amounts to testing the joint hypothesis that $a = \delta = 0_N$. If this hypothesis is upheld, it implies that for every test asset, we can obtain a portfolio of the K benchmark assets that has the same expected return (because $a = 0_N$ and $\beta 1_K = 1_N$) and a lower variance (because $R_{1,t}$ and ε_t are uncorrelated while $Var(\varepsilon_t)$ is positive definite). We perform both joint spanning and step-down tests, where α=0 and β=1 are tested separately. The OLS tests assume the error terms are normally distributed and homoskedastic. In order to test the robustness of this assumption, we also perform all tests using the Generalised Method of Moments (GMM) approach. The GMM approach has the advantage that it does not require information on the exact distribution of the error terms. Further details of deriving the tests are provided by Kan & Zhou (2012).

The null hypothesis states that the benchmark portfolio spans the portfolio of the benchmark assets plus the test assets. If the null hypothesis of spanning is rejected, this does not provide information about the magnitude of the shift in the efficiency frontier. We measure the economic significance of the diversification benefits using changes in the Sharpe (1964) ratio. We calculate the Sharpe ratio for the mean-variance efficient portfolio based on the *K* benchmark assets (and a risk-free asset) and the Sharpe ratio for the mean variance efficient portfolio based on all *K + N* assets (and a risk free asset), both in the case of frictionless markets and in the case of short

selling constraints. A difference between the Sharpe ratios of the benchmark and extended set assets indicates that investors can increase their risk-return trade off by investing in the N additional assets. If there is spanning, then there is no improvement in the Sharpe ratio possible by including the additional assets in the portfolio.

4. Results

Patterns of firm-level internationalisation

Panel A of Table 3 divides firms into categories based on their percentage of foreign sales. Of our 396 firms, between 111 and 129 firms have no foreign sales in any year. The number of firms with over 50 percent foreign sales increases every year from 46 in 1996 to 125 in 2010, with the exception of 1999 to 2000, when the number fell from 56 to 52, coinciding with the end of the dotcom bubble. The 2007/08 credit crisis had no impact on the numbers of firms with over 50 percent foreign sales, increasing from 112 to 120 in that year. The average foreign sales of all firms rise from 20.44 percent in 1996 to 30.98 percent in 2010. Panel B categorises firms by the number of geographic segments in which they report material foreign sales. The number of firms reporting 1 or 2 segments falls gradually. The number of firms reporting 5 to 9 segments varies from year to year, but there is no decline in the total number of firms reporting 5 segments and over in any year. The average number of segments for all firms increases from 2.25 in 1996 to 3.33 in 2010 and increases in every year. Panel C categorises firms by the number of regions in which their reported segments are located. The number of firms with sales in 4, 5 and 6 regions has increased significantly since 1996. 41 firms had sales in 4 regions in 1996, which rises to 73 in 2010. For firms with sales in 5 regions the number increases from 24 to 58, and for 6 regions from 4 to 16. Very few internationalised firms only have sales in North America; the maximum was 8 in any year. The average number of regions for all firms increases from 1.87 in 1996 to 2.35 in 2010. Overall, we find a very steady increase in the level, dispersion and location of foreign sales of MNCs over the sample period. By 2010 we find that almost 75 percent of MNCs are at least semi-global, with sales in at least 3 of the 6 regions of the world while almost 50 percent have sales in at least 4 regions. We find that the level and scope of firm-level internationalisation is increasing over time with some periods of more rapid internationalisation, and with the majority of MNCs pursuing at least a semi-global strategy as suggested by Stevens & Bird (2004) and Osegowitsch & Sammartino (2008).

We next examine the changes in firm internationalisation over time. Panel A of Table 2 lists the results for percentage foreign sales. Only 5 firms, Borgwarner, Celgene, Royal Caribbean Cruises, Williams-Sonoma and Yum! Brands, had increasing foreign sales in every year and only 1 firm, Frontier Oil, had decreasing foreign sales in every year. The only firms with no change were those which had no foreign sales in any year. 234 firms experienced an overall increase in their percentage foreign sales, while only 52 experienced an overall decrease. 2 firms increased by over 80 percent, Popular Inc. increased its foreign sales from 0 percent in 1996 to 88 percent in 2010. Schlumberger increased from 0 in 1996 to 81 percent in 2010. 2 firms decreased by over 50 percent; Forest Oil decreased from 73 percent in 1996 to 17 percent in 2010 and Altria, a tobacco company, decreased by 56 percent in 1996 to 0 in 2010. 3 firms had over 70 percent foreign sales in every year, Exxon, Manpower Group and Expeditor International. Panel B lists the results for the number of segments reported by each firm. 138 firms experienced no change in the number of segments. 72 firms increased in every year, and 20 decreased in every year. 184 firms increased overall between 1996 and 2010, while 33 decreased overall. The firm with the largest increase was Gilead Sciences, it increased by 9 segments overall, from 1 in 1996 to 10 in 2010. The largest decrease was 3 segments; Foot Locker fell from 5 segments in 1996 to 2 in 2010. 4 firms reported at least 6 segments in every year; Boeing, Expeditor International, Mc Dermott Inc., and Shaw Group. Panel C lists the results for the number of regions in which each firm's sales are located. 152 firms had no change, 69 increased in every year and 25 decreased in every year. 150 firms had an increase of at least 1 region between 1996 and 2010, while 45 decreased by at least 1 region. 7 firms had the largest increase of 4 regions, 3 firms had a fall of 3 regions. Diamond Offshore Drilling reported sales in all 6 regions of the world every year between 1996 and 2010.

By all three measures of internationalisation more firms increased than decreased in internationalisation; almost 5 times as many firms in percentage foreign sales, 6 times as many in the number of segments and 3 times as many in the number of regions. In each case the greatest increase in each measure is larger than the greatest decrease. For percentage foreign sales, the greatest increase is 88 percent and the greatest decrease 57 percent. For the number of segments the greatest increase is 9 and the greatest decrease is 3. For the number of regions, the greatest

increase is 4 and the greatest decrease is 3. This confirms an overall pattern of increasing internationalisation for firms as a whole, consistent with the increasing average levels of each measure in Table 2.

We compare the averages of the three measures of internationalisation to check their consistency with each other. In Table 3, Panel A lists the average percentage foreign sales for firms with each number of regions, Panel B lists the average number of geographic segments for each number of regions and Panel C shows the average percentage sales for firms with each number of geographic segments. The average percentage foreign sales do not consistently increase with a greater number of segment or regions. For 12 out of 15 years the average foreign sales are lower for firms with sales in 6 regions than for those with sales in 5 regions and for firms reporting 7 to 10 regions, foreign sales do not consistently increase. This highlights that percentage foreign sales are not necessarily higher for firms with greater numbers of segments or regions, and that the measures are capturing different aspects of internationalisation. The average number of segments consistently increases with the number of regions, these measures are consistent with each other at an aggregate level. However, when firms are ranked by the different measures, there is little overlap in the highest ranked firms. For example, Popular Inc. and Schlumberger Ltd. have the greatest increases of over 80 percent in foreign sales but not in either of the other two measures. Of the 21 firms with an increase of over 50 percent in foreign sales, only 5 of them also have the greatest increases in either of the other two measures (Apache, Atmel, Corning, Jabil Circuit Inc., and Maxim Integrated Products). Of the 26 firms which always have over 50 percent foreign sales, only 2 of those firms also always have sales in at least 5 geographic segments (Applied Materials, Expeditor International) and only 6 always have sales in at least 4 regions (3M, the Coca-Cola Co, Colgate-Palmolive, Expeditor International, Pall Corp, Lubrizol Co.). There is only one firm, Rowan Co, which features in the sample of firms with the greatest increase in the number of segments (6 and over) and in the sample of firms with the greatest increase in the number of regions (3 and over). Therefore, although the number of segments and regions are consistent at an aggregate level, at a firm level this is not the case.

To illustrate the changing patterns of internationalisation at a firm level we graph the internationalisation of three firms, Apache Corporation, Gilead Sciences and Intel Corporation,

over our 15 year period in Figure 2. Apache Corporation increases steadily in all three measures, its foreign sales increasing from 10% to 66% and its number of geographic segments from 3 to 7 and regions from 2 to 6. From listing sales in the US, Canada and 'other international' in 1996 it lists sales in the US, Europe, Asia, Africa, South America and Australia in 2010. Its increase in internationalisation was achieved through a series of acquisitions. In the 1990s, the firm acquired Hadson Energy Resources, Qarun Concession and Shell, facilitating entry into Egypt, Australia and the Gulf of New Mexico. In 2003 they acquired a large oilfield in the UK North Sea from BP.[8]

The path of internationalisation for Gilead Sciences is more varied. With no foreign sales in 1996, things changed dramatically for the firm in 1999 when they acquired NeXstar Pharmaceuticals, a firm with three times the sales of Gilead Sciences at the time. Percentage foreign sales rocketed to a peak of 83 percent in 1999, decreasing to 46 percent by 2010. Other acquisitions followed of the US and Canadian firms, Triangle Pharmaceuticals and Raylo Chemicals. The number of segments increased from 1 (the US) in 1996 to 10 in 1999, listing sales in the following geographic segments; US, Germany, the UK, Italy, Switzerland, Spain, France, Sweden, Other European Countries and Other Foreign Countries. The number of regions increased from 0 to 3 in 1999, with sales in every year since in North America, Europe and Australia (listed in Other Foreign Countries). In 2009 the company received the award for one of the Fastest Growing Companies by Fortune.[9]

Finally, we analyse the internationalisation of Intel Corporation. Percentage foreign sales fell from 76 to 56 percent in 1997, but rose again in 2002 to 71 percent, peaking at 85 percent in 2005. The number of segments fell in 1997 to 4 but increased again to 7 by 2002. In 2010 it listed sales in 10 geographic regions defined as; US, Taiwan, China, Europe, Japan, Asia Pacific, Other Americas, Ireland, Foreign and Others. The number of regions fell in 1997 to 3 but rose again to 5 in 2010. Intel was involved in antitrust legal proceedings in the US in 1997, this may have adversely affected its level of internationalisation.[10] Prior to 2010, the firm was not involved in any major acquisitions; its growth and increasing internationalisation were generated internally. These three firms follow very different processes of internationalisation. Over the period examined, Apache followed a gradual process of internationalisation predominantly through a series of acquisitions. However, its expansion into Egypt does not follow the theory of

gradually internationalising into geographically or culturally close countries as suggested by the Uppsala model. Gilead Sciences could be termed a 'born-again' global firm as defined by Bell et al. (2001), with its dramatic increase in internationalisation in 1999. However, this is not sustained and periods of de-internationalisation also occur. Authors such as Benito & Welch (1997) and Crick & Jones (2000) recognise that, contrary to some theories of internationalisation that suggest a process where firms become incrementally more internationalised over time, firms also experience periods of de-internationalisation as part of this process. Intel begins the period as a highly internationalised firm and maintains a level of at least 50 percent foreign sales in at least 4 segments in 3 regions in every year. However, it too experience periods of de-internationalisation as part of a gradual increase over time.

Portfolios correlations of variously internationalised firms

In Table 4 we list the correlation of equally weighted portfolios of MNCs with a portfolio of purely domestic firms. In Panel A the correlation with domestic firms decreases as the percentage of foreign sales increases. In Panel B the correlations decrease overall as the number of segments increases. In almost every year the correlations for firms with at least 6 segments are lower than those for firms with over 50 percent foreign sales. In Panel C, the correlations are lower in many cases for firms with sales in one region than for firms with sales in greater numbers of regions. However, this result may be distorted by the fact that there are only between 4 and 8 firms with sales in one region in any year. Apart from this the correlations with the benchmark portfolio decrease overall as the number of regions increases. The correlations for global firms are lower in every year than the correlation for firms with over 50 percent foreign sales. Firms with the highest number of segment or regions are less correlated with domestic firms than firms with the highest percentage foreign sales. The highest average correlations across all measures are in 2002 and in 2008, 2009 and 2010. This may be due to the downturn after the credit crisis of 2007/08, consistent with the well documented observation that correlations tend to rise during market downturns (Longin & Solnik, 1995; Karolyi & Stulz, 1996; Asness et al., 2011).

In Table 5 we list the annualised mean, standard deviation and return per unit of risk of portfolios of firms. In Panel A, it can be seen that almost all of the portfolio returns were negative in 2002 and 2008, with some negative returns in 1999, 2001 and 2007. In some years the return

increases as the level of internationalisation increases. In 1996, 2007, 2009 and 2010 many of the portfolios of MNCs have higher returns than the domestic firms. Overall however, the results are mixed, with little discernible pattern between internationalisation and average returns in other years. In Panel B, up to 2006 and in 2010 most of the portfolios of MNCs have a higher standard deviation than the portfolio of domestic firms.

Longitudinal Portfolios of MNCs

After our analysis of firms on an annual basis we form longitudinal portfolios which categorise firms by their changes in internationalisation over time. Using our results from Table 2, we form portfolios of firms with the greatest change and with the least change in our three measures of internationalisation, and we compare their diversification benefits. We create six Type 1 portfolios of the fastest internationalising firms, firms with an increase of 40 and 50 percent in foreign sales, an increase of 5 and 6 in geographic segments, and an increase of 2 and 3 in the number of regions. In addition we create a portfolio of firms with the greatest increase in all 3 measures. Given that there is little overlap in the firms with the greatest increase in each measure, we must select firms with smaller increases in internationalisation in each measure to ensure enough firms in the portfolio. We select those firms with an increase of 20 percent foreign sales, 3 segments and 2 regions, of which there are 24.

We create six Type 2 portfolios of firms with the consistently highest levels of internationalisation, firms that have above 25 and 50 percent foreign sales in every year, firms that report at least 4 and 5 geographic segments in every year and firms that have sales in at least 3 and 4 regions in every year.[11] In addition we create a portfolio of firms with the highest level of internationalisation in all three measures in every year. 31 firms have at least 25 percent foreign sales, in 4 geographic segments and in 3 regions in every year. To compare the diversification benefits of portfolios of MNCs we form a benchmark portfolio of the 104 firms which have no foreign sales in any year. For each of our portfolios we test the null hypotheses that a portfolio of MNCs is spanned a benchmark portfolio of domestic firms.

Diversification benefits

Table 6 lists the annualised mean, standard deviation, return per unit of risk, correlation with the S&P500 and correlation with domestic firms for each portfolio. The return per unit of risk is

0.33 for the S&P500 and 0.39 for the portfolio of domestic firms, consistent with our findings that in many cases there is little discernible pattern between the risk-adjusted return of the portfolio and the level of internationalisation of the firms in the portfolio. While the returns for the two portfolio types are mixed, the risk of Type 2 portfolios are lower than Type 1. Three portfolios have a higher risk-adjusted return than the S&P500. Three Type 2 portfolios have a higher risk-adjusted return than domestic firms; 0.40 for firms with at least 4 segments every year, 0.49 for at least 5 segments, and 0.49 for at least 5 regions in every year, and 5 are higher than the S&P500. For the portfolios of firms with the highest level of internationalisation in all measures, the risk-adjusted return is 0.38 for Type 1 portfolios and 0.37 for Type 2 portfolios. The correlation of all of the portfolios is lower with domestic firms than with the S&P500. For each measure of internationalisation, the correlation decreases in every case as the level of internationalisation increases. We next examine the diversification benefits of the longitudinal portfolios of MNCs.

Our mean variance tests investigate whether US investors can gain indirect international diversification benefits by investing in domestic MNCs. Our benchmark portfolio contains firms which have no foreign sales in any year. The test assets are portfolios of firms with the highest levels and speed of internationalisation. We conduct the following mean variance spanning tests equivalent to equation (2) as presented in equation (3), and test the joint hypothesis that $a = \delta = 0_N$.

$$R_{MNC,t} = \alpha + \beta R_{D,t} + \varepsilon_t \tag{3}$$

where $R_{MNC,t}$ are the returns of a portfolio of MNCs and $R_{D,t}$ are the returns of a portfolio of domestic firms.

In Table 7 we report the F-statistics and p-values from the Wald test. The p-value represents the probability of not rejecting the null hypothesis of spanning, that the benchmark portfolio spans the extended set of the benchmark plus the test assets. The results are listed firstly for the joint hypothesis of spanning, and subsequently for the step-down tests, where $\alpha=0$ and $\beta=1$ are tested separately, for both OLS and GMM estimation. In Panel A the joint spanning results for both

OLS and GMM estimation indicate that we do not reject spanning for any of the Type 1 portfolios. The addition of portfolios of the fastest internationalising firms does not shift the mean-variance efficient frontier of the portfolio of domestic firms. Firms with rapidly expanding operations overseas do not provide international diversification benefits to domestic investors, when portfolios are equally weighted. The results for joint spanning for OLS and GMM estimation in Panel B indicate that we do reject the null hypothesis for almost all of the portfolios of the most consistently international MNCs. The exception is for firms with over 50 percent foreign sales and over 3 regions, for which we do not reject spanning at the 10 percent critical level using GMM estimation. There is a clear difference in the results for $\alpha = 0$ and $\beta = 1$. For the step-down test for $\alpha = 0$, we do not reject the null hypothesis that the tangency point of the extended set is not statistically different to the tangency point of the benchmark portfolio of domestic firms. The results for $\beta = 1$ suggest that the minimum variance portfolio of the extended set is statistically different from the benchmark portfolio. In order to calculate the economic magnitude of the shift in the mean-variance efficient frontier, we calculate the Sharpe ratio of the extended set of the benchmark portfolio plus the MNC portfolio by optimising the weight in the benchmark portfolio and in the MNC portfolio. We calculate the change from the Sharpe ratio of the benchmark portfolio. Bekaert & Urias (1996) suggest that only Sharpe ratio t changes of above 0.057 are significant. The Sharpe ratio changes are only significant for those firms with the highest levels of internationalisation for each measure. For firms that have over 50 percent foreign sales in every year the Sharpe ratio increase is 24 percent. For firms with sales in at least 5 geographic segments every year, the increase is 50 percent. And for firms with sales in at least 4 regions every year, the increase is 48 percent. Overall, we find that firms which are consistently the most international, with sales in the greatest number of geographic segments or across the most regions provide the greatest diversification benefit to a US investor.

In Table 8 we repeat the diversification tests where the weight of each MNC in the portfolios of the most internationalised firms is optimised, with and without short sales. Optimal weights cannot be determined ex-ante and are highly sensitive to the returns over the period. We consider equally weighted portfolios to be a better indicator of diversification benefits, with optimised weights as a robustness test. In all cases p-values of between 0 and 0.04 lead us to reject spanning, that is, that the benchmark portfolio does not span the extended portfolio. There are very substantial increases in the Sharpe ratios of between 100 and 373 percent. Both Type 1

and Type 2 portfolios of MNCs provide diversification benefits to US investors when portfolio weights are optimised. When short sales are not permitted, the increases are larger for Type 2 portfolios, those of the most consistently international MNCs. When short sales are permitted, the increases are greater for Type 1 portfolios in 2 out of 3 cases. When short sales are not permitted, the most consistently international firms outperform the fastest internationalisers. When short sales are permitted, the fastest internationalisers outperform as poorly performing firms can be shorted.

We find that highly internationalised firms provide diversification benefits, particularly when using the measures other than foreign sales. The results for the fastest internationalising firms may be due to the costs of rapid internationalisation, which may initially outweigh the benefits of internationalisation. Rapid internationalisation has costs, and this erodes the diversification benefits available to investors who invest in rapidly internationalising firms. In this case, the costs of rapid internationalisation can actually outweigh the benefits and end up yielding a risk-return profile that is *below* that of domestic firms. When firms have established a high level of internationalisation, the diversification benefits increase. We would suggest that a savvy investor should short firms that are in the process of rapid internationalisation and go long firms with an established record of a high level of internationalisation in a wide geographic scope.

5. Conclusions and suggestions for future work

The purpose of this paper is to contribute to the literature on the indirect international diversification benefits of investing in MNCs. We conduct a longitudinal study of the internationalisation of US firms which gives us unique insights into the changing levels of internationalisation over time. We compare the diversification benefits of portfolios when firms are selected by the extent and breadth of their overseas activities. We test whether firms which are consistently the most international or whose level of internationalisation has increased the most offer the best risk reduction.

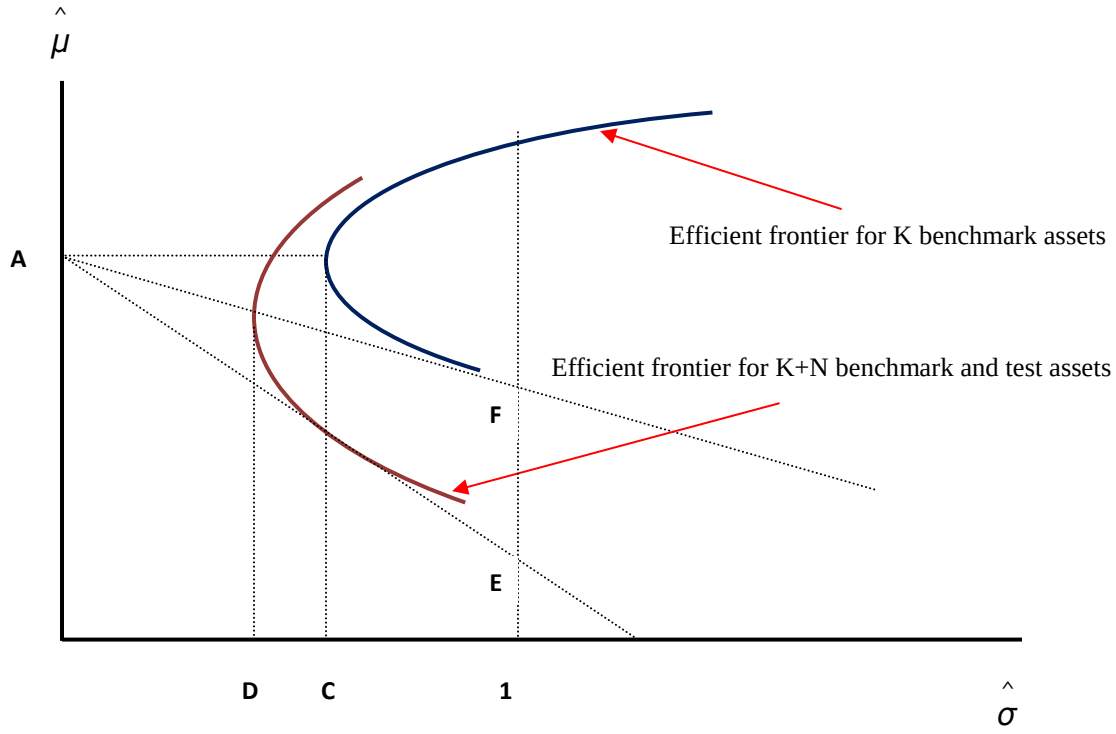
We find a substantial increase in the level of internationalisation of MNCs between 1996 and 2010, while the number of firms with no foreign activity remains relatively unchanged. Using a richer dataset than exists in the literature we find that greater benefits can be gained by selecting firms with the greatest dispersion and widest location of sales than by the level of foreign sales.

Frankel & Rose (1998) find that as trade decreases with distance, so too does business cycle correlation, therefore firms operating far from their domestic market could be expected to deliver greater diversification benefits. When no short sales are permitted, firms which are consistently the most international rather than those which increase the most in internationalisation provide greater diversification benefits. Firms which are *already* international provide greater benefits than those which *have become* more international. This may be due to the costs of rapid internationalisation which can erode and in some cases outweigh the diversification benefits. We find that a longitudinal selection method is superior to selection at one point in time. Most prior studies select MNCs by the level of their foreign sales at a single point in time, (Fatemi, 1984; Qian, 1996; Antoniou et al., 2010); we find greater benefits when firms are selected based on measures of internationalisation observed over time and using measures other than percentage foreign sales. As argued by Aharoni (2006), by not using longitudinal data, the research fails to capture the dynamics of firm internationalisation. This study addresses that gap in the literature. Our results demonstrate that portfolios of US MNCs offer significant home-based international diversification benefits. Investors can free ride the benefits of internationalisation without incurring the costs and risks of investing abroad. It can be concluded that, as suggested by Cai & Warnock (2012), the home bias observed in equity portfolios may be overstated when the indirect international exposure available via internationalised firms is not included.

A recommendation for future study would be to extend our longitudinal study of the internationalisation of MNCs in other countries to investigate whether MNCs have increased in internationalisation to the same extent as in the US since the mid-nineties, and to test the indirect diversification benefits of MNCs outside the US. Doremus et al. (1998) argue that MNCs internationalise differently depending on their nation of origin. Given that the US is the largest economy in the world, its MNCs may have internationalised faster and have greater global reach than others. Alternatively, given the large size of the domestic market in the US, other countries may have a lower percentage of firms with no activity outside of their domestic market.

Figures & Tables

Figure 1
Wald test for mean variance spanning



Notes. This depiction of the Wald test for mean variance spanning is derived from Kan and Zhou (2001). The geometry of the test is: Wald = (OC/OD)2 – 1 +(AE/AF) – 1

Figure 2
Efficient frontiers of highly internationalised and rapidly internationalising firms

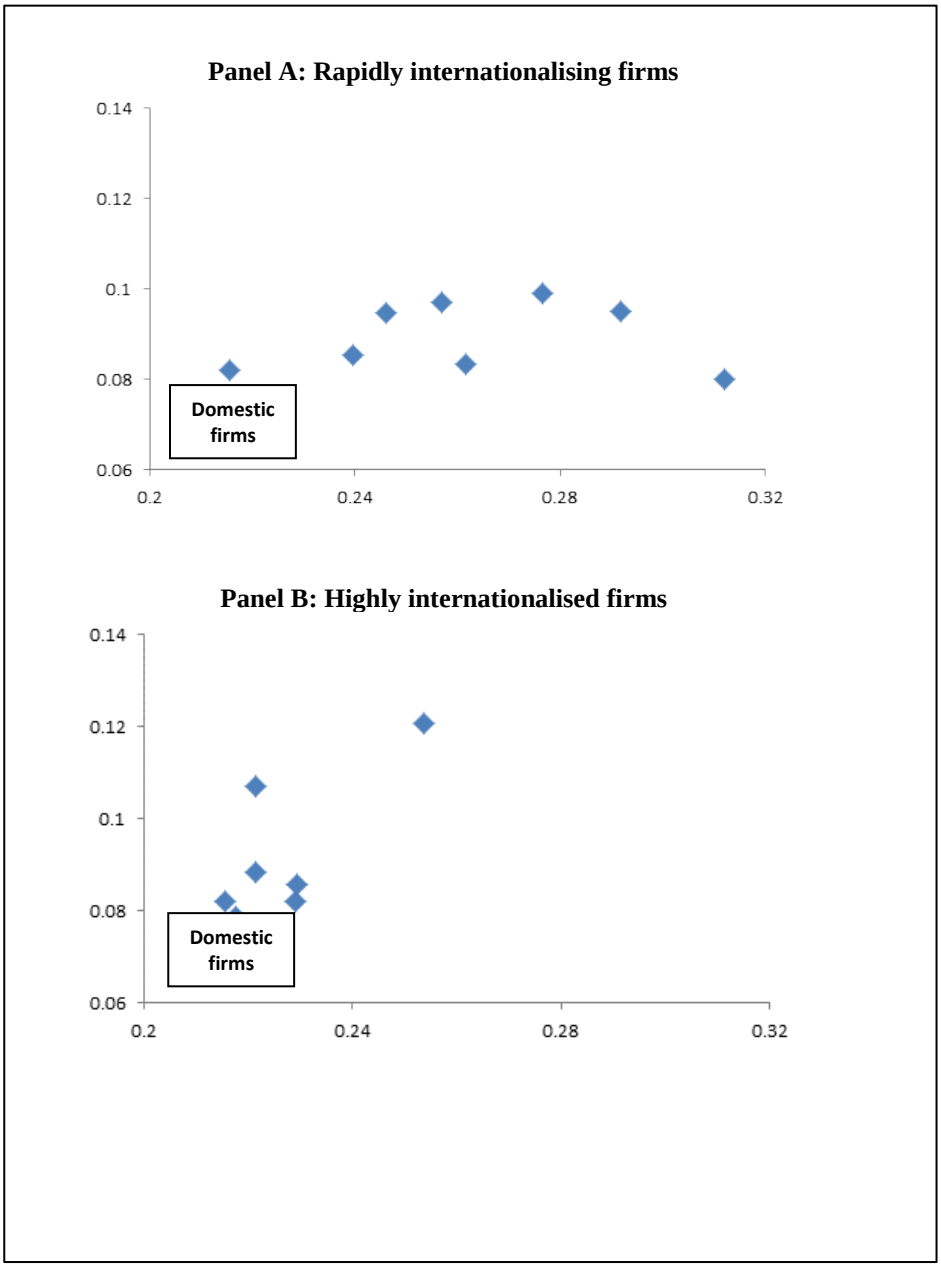
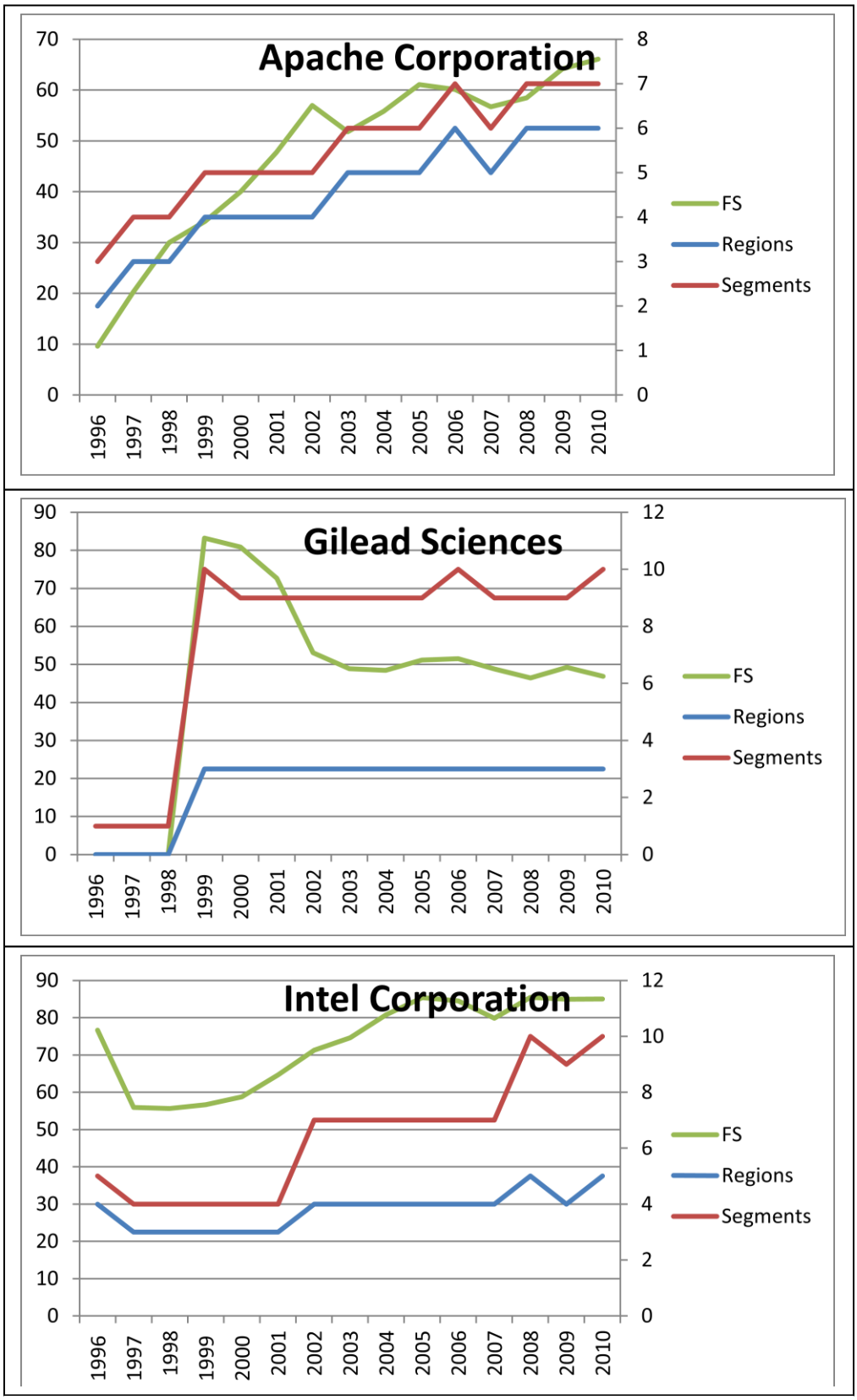


Figure 3 The Internationalisation of Individual Firms



Notes: These graphs show the changes in 3 measures of internationalisation for three firms over time, percentage foreign sales are graphed on the left axis and number of segments and regions on the right.

Table 1
Data description and sources

Regions: Dividing the world into six regions: Africa, Asia, Europe, North America, Oceania and South America, firms are classified as domestic (D) if they have no foreign sales; as regional (R) if all their sales are in North America; as transregional (T) if they have some sales in North America and other regions; and firms with sales in all six regions are classified as global (G). Source: Aggarwal et al (2011).

Firms: All firms from the Russell 1,000 Index for which we have the full set of required data from 1996 to 2010. The Russell Index is a market value weighted index and represents approximately 92 per cent of the US market. Source: Datastream.

FS: Foreign sales of each firm. Source:

FS/TS: Ratio of foreign sales (FS) to total sales (TS).

NoRegsThe number of regions used by the firm to report foreign sales in its K10 reporting. The relevant accounting standard for geographical segment disclosure does not specify a quantitative threshold for 'material' sales or assets, it is assumed to between 5 and 10 per cent.

Rf: Risk free rate 3 month T-Bill

Rm: Weekly return on the S&P500 index from January 1996 to December 2010. Source: Datastream.

TS: Total sales of each firm. Source: Datastream.

Table 2 Number of Firms by Measure of Internationalisation

Number of firms	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Panel A: % Foreign Sales															
No foreign sales	129	126	123	119	120	118	116	116	115	114	114	111	111	112	113
Over 0% and under 25%	101	107	91	84	86	90	82	73	75	68	67	63	57	58	55
Over 25% and under 50%	120	117	134	137	138	126	125	125	115	118	118	110	108	104	103
Over 50%	46	46	48	56	52	62	73	82	91	96	97	112	120	122	125
Total	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396
Average % Foreign Sales	20.44	20.65	21.66	22.88	22.63	23.19	24.20	25.90	26.98	27.58	28.04	29.61	30.32	30.34	30.98
Panel B: Number of Geographic Segments															
1	131	127	123	119	120	118	116	116	116	114	113	111	112	112	113
2	79	77	80	75	72	79	72	72	66	64	59	62	59	56	55
3	105	97	77	70	78	71	71	55	53	53	55	58	57	50	46
4	56	60	72	75	65	61	57	65	69	66	67	58	53	60	50
5	18	27	23	31	32	36	47	49	52	52	46	50	55	49	52
6	6	5	15	8	11	12	9	15	17	19	22	29	28	22	26
7	1	2	3	10	10	9	10	10	6	12	17	10	9	20	23
8	0	0	2	4	3	3	3	4	5	5	7	4	8	7	8
9	0	1	1	2	3	3	6	5	6	3	2	4	5	8	6
10	0	0	0	2	2	4	5	5	6	8	8	10	10	12	17
Total	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396
Average No of Segments	2.25	2.34	2.46	2.62	2.63	2.66	2.78	2.84	2.90	2.97	3.04	3.04	3.10	3.22	3.33
Panel C: Number of Regions															
Domestic US only (0)	130	126	123	119	120	117	116	117	116	115	114	112	113	113	114
North America (1)	5	6	4	4	5	6	6	8	7	6	7	8	8	8	6
2 Regions (2)	88	81	86	82	81	84	77	70	68	70	63	67	64	60	66
3 Regions (3)	104	108	99	93	96	95	100	91	89	88	84	79	79	79	63
4 Regions (4)	41	42	47	59	63	61	61	67	75	68	78	76	67	68	73
5 Regions (5)	24	28	32	31	27	26	28	34	30	39	36	42	48	55	58
Global (6)	4	5	5	8	4	7	8	9	11	10	14	12	17	13	16
Total	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396
Average No of Regions	1.87	1.94	1.99	2.07	2.02	2.04	2.08	2.13	2.16	2.19	2.25	2.25	2.30	2.31	2.35

Notes: This table shows how many firms are in each category in each year for the 3 measures of internationalisation. Panel A counts the number of firms in each category of percentage foreign sales, followed by the average foreign sales of all firms in each year. Panel B counts the firms with each number of geographic segments reported by the firm, followed by the average number of segments reported by all firms in each year. Panel C counts the number of firms with sales in each number of regions, followed by the average number of regions of all firms in each year. For example in 1996 129 firms have no foreign sales, while the average percentage sales of all 396 firms is 20.44%.

Table 3 Longitudinal Patterns of Internationalisation

Changes in Internationalisation	*No of Firms*	*Decreases in Internationalisation*	*No of Firms*	*Thresholds in Every Year*	*No of Firms*
		Panel A: Foreign Sales			
No change (from 0%)	107				
Only increased	5				
Only decreased	1				
> 0% Increase Overall	234	> 0% Decrease Overall	52	> 0%	289
> 10% Increase Overall	171	> 10% Decrease Overall	21	> 10%	212
> 20% Increase Overall	101	> 20% Decrease Overall	9	> 25%	128
> 30% Increase Overall	57	> 30% Decrease Overall	5	> 50%	26
> 40% Increase Overall	36	> 40% Decrease Overall	3	> 60%	7
> 50% Increase Overall	21	> 50% Decrease Overall	2	> 70%	3
> 60% Increase Overall	11				
> 70% Increase Overall	2				
> 80% Increase Overall	2				
		Panel B: Number of Segments			
No change	138				
Only increased	72				
Only decreased	20				
>= 1 segment increase	184	>= 1 segment decrease	33	>= 2 segments	257
>= 2 segment increase	125	>= 2 segment decrease	8	>= 3 segments	147
>= 3 segment increase	72	>= 3 segment decrease	1	>= 4 segments	48
>= 4 segment increase	51			>= 5 segments	12
>= 5 segment increase	34			>= 6 segments	4
>= 6 segment increase	19				
>= 7 segment increase	15				
>= 8 segment increase	8				
>= 9 segment increase	1				
		Panel C: Number of Regions			
No change	152				
Only increased	69				
Only decreased	25				
>= 1 region increase	150	>= 1 region decrease	45	>= 1 regions	256
>= 2 region increase	79	>= 2 region decrease	15	>= 2 regions	249
>= 3 region increase	31	>= 3 region decrease	3	>= 3 regions	129
>= 4 region increase	7			>=4 regions	29
				>=5 regions	8
				=6regions	1

Notes: This table shows the changes in each measure of firm internationalisation. Panel A counts the number of firms with no change and several levels of increases and decreases in foreign sales over the period. It also counts the firms which have foreign sales over a number of thresholds in every year. For example 2 firms had an increase of 80% in foreign sales from 1996 to 2010 while 3 firms had foreign sales of over 70 percent in every year. Panel B counts the number of firms with increases, decreases and which stay above thresholds in every year for the number of segments. Panel C repeats the same for the number of regions.

Table 4 Comparing Measures of Firm Internationalisation

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Panel A: Average Percentage Foreign Sales for each Number of Regions															
North America (1)	18	17	16	16	14	12	9	11	12	16	15	15	13	12	10
2 Regions (2)	25	25	26	26	27	27	27	30	30	28	28	29	32	30	32
3 Regions (3)	32	34	36	38	38	38	39	41	44	44	46	48	49	50	48
4 Regions (4)	40	36	36	38	37	40	44	46	46	49	48	51	51	51	53
5 Regions (5)	52	47	46	43	45	43	46	45	50	52	50	55	53	52	56
Global (6)	38	40	35	46	45	41	39	42	45	44	45	49	52	54	51
Panel B: Average Number of Geographic Segments for each Number of Regions															
North America (1)	1.8	2.0	1.8	1.8	2.0	1.7	1.9	2.0	1.9	1.8	2.0	2.0	2.0	2.0	1.8
2 Regions (2)	2.2	2.2	2.2	2.2	2.2	2.1	2.2	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.5
3 Regions (3)	3.3	3.3	3.5	3.6	3.8	3.7	3.7	3.9	4.0	4.1	4.1	3.9	3.9	4.0	4.1
4 Regions (4)	3.9	4.0	4.4	4.5	4.6	4.8	4.9	5.0	4.8	4.9	5.0	5.2	5.4	5.6	5.6
5 Regions (5)	4.4	4.6	4.9	5.3	5.6	5.7	5.9	5.6	6.0	6.0	5.9	5.9	5.9	5.9	6.1
Global (6)	5.3	6.2	5.8	6.8	7.3	7.0	7.8	7.4	7.3	6.5	6.6	6.6	6.5	7.2	7.2
Panel C: Average Percentage Foreign Sales for Each Number of Segments															
2	22	21	24	26	26	26	25	28	28	29	28	28	31	29	31
3	34	35	34	35	36	37	37	38	40	38	39	42	42	42	42
4	41	39	41	38	37	36	39	41	43	41	42	46	46	48	47
5	47	40	42	40	39	44	43	44	45	47	50	52	51	50	49
6	41	31	38	43	42	45	58	55	55	56	53	51	55	51	58
7	45	58	41	48	49	46	47	53	61	68	54	59	60	63	55
8			22	39	22	42	27	33	47	38	53	68	54	51	59
9		64	14	20	57	48	47	48	52	47	47	48	45	47	66
10				55	42	41	46	49	54	56	58	61	65	64	64

Notes: This table compares the three measures of internationalisation. Panel A shows the average percentage foreign sales of firms with each number of regions in each year. For example, for global firms in 1996, the average percentage foreign sales are 35%. Panel B shows the average number of geographic segments for firms with each number of regions. Panel C shows the average percentage foreign sales for firms with each number of geographic segments.

Table 5 Correlations of Portfolios of Firms

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Panel A: Percentage Foreign Sales															
Under 25%	87%	89%	95%	84%	82%	81%	96%	95%	90%	89%	91%	89%	94%	95%	95%
Over 25% and under 50%	86%	88%	93%	86%	68%	73%	95%	93%	85%	88%	91%	91%	95%	94%	95%
Over 50%	78%	78%	89%	78%	50%	53%	87%	89%	77%	83%	84%	89%	91%	92%	93%
Panel B: Number of Geographic Segments															
2 segments	86%	90%	95%	84%	82%	81%	96%	95%	90%	91%	94%	93%	96%	95%	96%
3 segments	84%	83%	92%	83%	61%	66%	91%	93%	83%	85%	87%	89%	95%	96%	92%
4 segments	84%	86%	90%	84%	69%	70%	94%	92%	83%	83%	92%	87%	94%	94%	94%
5 segments	76%	82%	91%	72%	76%	69%	92%	91%	83%	82%	84%	86%	91%	90%	93%
6 segments	73%	66%	88%	72%	38%	30%	82%	80%	64%	77%	83%	88%	90%	91%	91%
7 segments	37%	63%	82%	63%	39%	64%	79%	72%	60%	83%	77%	80%	78%	89%	93%
8 segments			72%	48%	51%	33%	79%	77%	76%	71%	71%	75%	86%	86%	85%
9 segments		41%	66%	34%	23%	60%	72%	79%	76%	68%	68%	77%	80%	91%	90%
10 segments				39%	5%	38%	73%	73%	70%	76%	78%	91%	85%	91%	91%
Panel C: Number of Regions															
North America (1)	49%	69%	80%	48%	63%	57%	90%	88%	82%	72%	77%	85%	92%	88%	87%
2 Regions (2)	87%	90%	95%	82%	82%	81%	96%	95%	90%	89%	91%	93%	96%	95%	95%
3 Regions (3)	81%	81%	93%	82%	58%	65%	92%	93%	82%	86%	89%	87%	94%	95%	93%
4 Regions (4)	83%	89%	91%	87%	71%	67%	90%	91%	80%	86%	89%	91%	93%	91%	93%
5 Regions (5)	87%	85%	88%	79%	57%	58%	91%	88%	80%	82%	88%	85%	90%	92%	93%
Global (6)	27%	50%	74%	48%	32%	55%	88%	78%	78%	72%	70%	82%	84%	90%	90%

Notes: This table shows the correlation of the firms in each category of internationalisation with the firms with no foreign sales in each year. For example firms with over 50 percent foreign sales in 1996 have a correlation of 82% with domestic firms.

Table 6 Risk and Return of Portfolios of Firms

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
							Panel A: Annualised Return								
Domestic	0.15	0.34	0.13	-0.07	0.20	0.13	-0.03	0.28	0.19	0.12	0.15	-0.11	-0.66	0.31	0.13
Under 25%	0.21	0.21	0.08	-0.04	0.12	0.07	-0.17	0.32	0.20	0.13	0.14	-0.04	-0.74	0.46	0.17
Over 25% and under 50%	0.24	0.22	0.01	0.15	-0.02	0.09	-0.18	0.31	0.16	0.11	0.14	0.09	-0.59	0.32	0.16
Over 50% FS	0.21	0.13	-0.04	0.35	0.04	-0.14	-0.24	0.33	0.12	0.12	0.14	0.13	-0.71	0.44	0.23
2 segments	0.24	0.23	0.08	-0.04	0.18	0.07	-0.15	0.27	0.19	0.11	0.11	0.00	-0.66	0.44	0.20
3 segments	0.20	0.19	0.05	0.09	-0.03	0.01	-0.27	0.37	0.14	0.06	0.13	0.12	-0.67	0.32	0.18
4 segments	0.23	0.16	-0.04	0.24	-0.09	0.11	-0.13	0.34	0.16	0.06	0.15	-0.04	-0.58	0.38	0.19
5 segments	0.26	0.20	0.00	0.16	0.00	0.00	-0.17	0.27	0.16	0.23	0.16	0.15	-0.59	0.33	0.16
6 segments	0.39	0.30	-0.07	0.36	-0.01	-0.05	-0.21	0.35	0.15	0.15	0.12	0.12	-0.82	0.45	0.24
7 segments	0.32	0.19	-0.14	0.59	0.17	-0.14	-0.32	0.42	-0.01	0.19	0.10	0.13	-0.54	0.52	0.16
8 segments			0.22	0.29	0.31	-0.46	0.01	0.42	0.16	0.28	0.06	0.22	-1.08	0.40	0.22
9 segments		0.18	0.29	-0.51	0.55	0.28	-0.25	0.30	0.20	0.20	0.68	0.35	-0.64	0.30	0.19
10 segments				-0.24	0.09	-0.17	-0.39	0.42	0.12	0.15	0.38	0.25	-0.85	0.59	0.32
North America (1)	0.20	0.23	0.14	-0.15	0.13	0.07	-0.12	0.26	0.17	0.09	0.10	-0.02	-0.55	0.34	0.15
2 Regions (2)	0.23	0.22	0.03	-0.03	0.15	0.09	-0.14	0.27	0.21	0.10	0.11	0.00	-0.64	0.36	0.16
3 Regions (3)	0.20	0.18	0.07	0.15	-0.06	0.06	-0.21	0.37	0.13	0.10	0.17	0.03	-0.65	0.37	0.11
4 Regions (4)	0.26	0.23	-0.07	0.24	0.02	0.06	-0.20	0.33	0.12	0.13	0.11	0.13	-0.67	0.42	0.31
5 Regions (5)	0.25	0.16	0.08	0.26	-0.04	-0.20	-0.26	0.33	0.20	0.16	0.18	0.15	-0.65	0.40	0.48
Global (6)	0.62	0.14	-0.57	0.18	0.38	-0.06	-0.10	0.13	0.24	0.23	0.21	0.30	-0.74	0.43	0.85
							Panel B: Annualised Risk								
Domestic	0.10	0.13	0.21	0.14	0.16	0.13	0.22	0.14	0.12	0.11	0.10	0.17	0.44	0.41	0.18
Under 25%	0.15	0.15	0.30	0.21	0.23	0.21	0.28	0.16	0.14	0.12	0.12	0.16	0.34	0.43	0.21
Over 25% and under 50%	0.14	0.18	0.26	0.16	0.17	0.18	0.25	0.16	0.14	0.11	0.11	0.15	0.38	0.40	0.17
Over 50% FS	0.15	0.21	0.29	0.18	0.23	0.23	0.31	0.20	0.18	0.14	0.16	0.16	0.39	0.36	0.14
2 segments	0.14	0.18	0.27	0.15	0.16	0.17	0.26	0.16	0.13	0.11	0.11	0.15	0.39	0.39	0.22
3 segments	0.14	0.20	0.29	0.18	0.22	0.24	0.31	0.18	0.17	0.12	0.15	0.17	0.38	0.38	0.24
4 segments	0.14	0.19	0.26	0.17	0.21	0.21	0.31	0.20	0.17	0.13	0.12	0.16	0.36	0.35	0.21
5 segments	0.18	0.18	0.26	0.18	0.17	0.21	0.31	0.17	0.14	0.14	0.15	0.16	0.35	0.32	0.21
6 segments	0.22	0.31	0.32	0.19	0.32	0.31	0.40	0.19	0.17	0.15	0.16	0.18	0.42	0.39	0.20
7 segments	0.20	0.33	0.50	0.23	0.32	0.27	0.26	0.25	0.15	0.18	0.19	0.21	0.39	0.41	0.26
8 segments				0.25	0.34	0.37	0.34	0.23	0.23	0.17	0.15	0.22	0.51	0.49	0.24
9 segments			0.47	0.45	0.46	0.40	0.39	0.31	0.21	0.19	0.41	0.25	0.40	0.45	0.30
10 segments				0.49	0.32	0.32	0.47	0.28	0.21	0.14	0.16	0.20	0.45	0.43	0.25
North America (1)	0.15	0.15	0.30	0.21	0.23	0.21	0.28	0.16	0.14	0.12	0.12	0.16	0.34	0.43	0.21
2 Regions (2)	0.14	0.18	0.26	0.16	0.17	0.18	0.25	0.16	0.14	0.11	0.11	0.15	0.38	0.40	0.17
3 Regions (3)	0.15	0.21	0.29	0.18	0.23	0.23	0.31	0.20	0.18	0.14	0.16	0.16	0.39	0.36	0.14
4 Regions (4)	0.16	0.18	0.27	0.18	0.19	0.22	0.33	0.20	0.16	0.13	0.13	0.17	0.37	0.34	0.37
5 Regions (5)	0.15	0.18	0.26	0.16	0.20	0.20	0.32	0.16	0.14	0.12	0.13	0.17	0.35	0.38	0.51
Global (6)	0.23	0.31	0.42	0.25	0.36	0.26	0.32	0.21	0.16	0.16	0.22	0.21	0.43	0.43	1.16
							Panel C: Return per Unit of Risk								
Domestic	1.54	2.63	0.61	-0.51	1.25	1.01	-0.16	2.00	1.55	1.11	1.47	-0.68	-1.51	0.75	0.68
Under 25%	1.45	1.35	0.26	-0.18	0.53	0.35	-0.61	1.99	1.41	1.10	1.24	-0.22	-2.20	1.09	0.81
Over 25% and under 50%	1.71	1.22	0.03	0.95	-0.09	0.49	-0.71	1.97	1.17	1.04	1.28	0.62	-1.53	0.80	0.95
Over 50% FS	1.41	0.63	-0.14	1.93	0.16	-0.61	-0.78	1.66	0.69	0.88	0.90	0.80	-1.83	1.23	1.67
2 segments	1.73	1.32	0.31	-0.24	1.14	0.44	-0.56	1.66	1.40	0.97	1.06	-0.02	-1.71	1.14	0.90
3 segments	1.37	0.97	0.19	0.51	-0.13	0.04	-0.88	1.99	0.85	0.49	0.85	0.75	-1.76	0.84	0.75
4 segments	1.64	0.86	-0.17	1.40	-0.44	0.54	-0.43	1.69	0.97	0.50	1.19	-0.27	-1.61	1.09	0.91
5 segments	1.46	1.12	-0.01	0.90	-0.03	0.02	-0.54	1.58	1.11	1.64	1.06	0.93	-1.68	1.02	0.76
6 segments	1.81	0.98	-0.21	1.86	-0.03	-0.17	-0.52	1.88	0.86	0.99	0.73	0.70	-1.94	1.15	1.17
7 segments	1.60	0.55	-0.29	2.56	0.54	-0.52	-1.24	1.71	-0.09	1.06	0.53	0.62	-1.38	1.28	0.61
8 segments				1.15	0.91	-1.27	0.04	1.83	0.71	1.66	0.40	1.00	-2.11	0.83	0.92
9 segments			0.63	-1.12	1.20	0.69	-0.64	0.98	0.97	1.04	1.68	1.43	-1.60	0.68	0.64
10 segments				-0.49	0.30	-0.54	-0.83	1.46	0.58	1.05	2.37	1.24	-1.88	1.37	1.28
North America (1)	1.34	1.50	0.46	-0.71	0.58	0.33	-0.44	1.66	1.18	0.72	0.89	-0.09	-1.62	0.79	0.72
2 Regions (2)	1.64	1.22	0.10	-0.22	0.92	0.53	-0.54	1.73	1.52	0.91	1.02	0.03	-1.67	0.92	0.92
3 Regions (3)	1.30	0.89	0.24	0.86	-0.27	0.25	-0.70	1.88	0.75	0.74	1.09	0.20	-1.68	1.03	0.77
4 Regions (4)	1.63	1.25	-0.26	1.30	0.10	0.29	-0.61	1.66	0.75	0.97	0.83	0.76	-1.81	1.23	0.83
5 Regions (5)	1.61	0.87	0.31	1.63	-0.22	-0.97	-0.81	2.06	1.41	1.27	1.36	0.91	-1.83	1.07	0.95
Global (6)	2.71	0.45	-1.35	0.74	1.05	-0.24	-0.32	0.59	1.53	1.44	1.00	1.42	-1.70	0.98	0.73

Notes: This table shows the annualised return, risk and return per unit of risk in each year for each category of firm. For example, the return per unit of risk is 1.65 for the portfolio of domestic firms in 1996.

Table 7 Longitudinal Portfolios of MNCs

	Mean	*StDev*	*Return/Risk*	*No of firms*	*Correlation with Domestic firms*	*Correlation with S&P500*
S&P500	6.53%	19.84%	0.33		87%	
Domestic in All Years	8.21%	21.54%	0.39	104		87%
Panel A: Type 1 Portfolios : Fastest Internationalisers						
>=40% increase in FS	9.52%	29.19%	0.33	36	74%	84%
>=50% increase in FS	8.00%	31.20%	0.26	21	70%	82%
>=increase of 5 segments	8.34%	26.16%	0.32	34	82%	89%
>= increase of 6 segments	9.89%	27.67%	0.36	19	78%	87%
>= increase of 2 regions	8.54%	23.96%	0.36	79	88%	92%
>= increase of 3 regions	9.47%	24.60%	0.38	31	86%	90%
Increase of 20% FS, 3 segments and 2 regions	9.72%	25.68%	0.38	24	80%	87%
Panel B: Type 2 Portfolios : Most consistently international						
>=25% FS in all years	7.86%	21.77%	0.36	128	86%	93%
>=50% FS in all years	5.17%	23.76%	0.22	26	81%	86%
>=4 segments in all years	8.85%	22.14%	0.40	48	83%	90%
>=5 segments in all years	12.08%	25.36%	0.49	12	78%	81%
>=3 regions in all years	8.21%	22.89%	0.36	129	86%	92%
>=4 regions in all years	10.70%	22.14%	0.49	29	85%	90%
>= 25% FS, 4 segments, 3 regions	8.58%	22.92%	0.37	31	81%	90%

Notes: This table shows the risk, return and correlations of equally weighted portfolios of firms. The portfolios in Panel A have the greatest increases in percentage foreign sales, number of segments and number of regions between 1996 and 2010. In Panel B, the results are listed for firms which remain above thresholds of foreign sales, segments and regions in every year between 1996 and 2010.

able 8 MVS Tests and Sharpe Ratio Results

	OLS						*GMM*								
	$\alpha = 0, \beta = 1$		$\alpha = 0$		$\beta = 1$		$\alpha = 0, \beta = 1$		$\alpha = 0$		$\beta = 1$				
	F-stat	p-value	F-stat	p-value	F-stat	p-value	F-stat	p-value	F-stat	p-value	F-stat	p-value	Sharpe ratio	% change	Sharpe ratio - no short sales
All Domestic Firms													0.24		
Panel A: Type 1: Fastest internationalisers															
>=40% increase in FS	0.09	0.91	0.05	0.81	0.12	0.72	0.05	0.95	0.06	0.82	0.13	0.84			
>=50% increase in FS	0.21	0.80	0.01	0.94	0.42	0.51	0.08	0.92	0.01	0.94	0.42	0.69			
>=increase of 5 segments	0.06	0.93	0.01	0.98	0.13	0.71	0.07	0.98	0.00	0.99	0.13	0.84			
>= increase of 6 segments	0.12	0.88	0.12	0.72	0.13	0.70	0.13	0.92	0.13	0.74	0.13	0.79			
>= increase of 2 regions	0.15	0.79	0.16	0.81	0.14	0.66	0.15	0.89	0.14	0.78	0.14	0.81			
>= increase of 3 regions	0.07	0.92	0.15	0.69	0.01	0.96	0.08	0.92	0.09	0.69	0.01	0.93			
Increase of 20% FS, 3 segments and 2 regions	0.91	0.41	0.48	0.63	1.6	0.21	0.29	0.75	0.20	0.65	0.38	0.53	0.26		
Panel B: Type 2: Most consistently international															
>25%	24	0.00	0.04	0.84	48	0.00	2.76	0.06	0.04	0.85	7.79	0.02	0.24	0%	0.24
>50%	10	0.00	0.45	0.50	21	0.00	1.40	0.12	0.42	0.52	3.75	0.05	0.30	24%	0.24
>=4 segments	26	0.00	0.30	0.58	52	0.00	4.40	0.01	0.27	0.60	8.05	0.01	0.26	9%	0.26
>=5 segments	5.58	0.00	1.33	0.25	10	0.00	7.49	0.02	1.25	0.26	3.46	0.06	0.36	50%	0.36
>=3 regions	9.6	0.00	0.04	0.83	18	0.00	2.23	0.19	0.04	0.85	3.27	0.07	0.24	1%	0.24
>=4 regions	22	0.00	1.38	0.24	43	0.00	4.72	0.00	1.22	0.26	10.5	0.00	0.36	48%	0.36
>= 25% FS, 4 segments, 3 regions	16	0.00	0.20	0.65	32	0.00	4.04	0.02	0.28	0.66	7.89	0.01	0.24		

Notes: This table shows the results for the Mean-Variance Spanning Tests and changes in the Sharpe Ratios, for the addition of equally weighted portfolios of MNCs to the benchmark portfolio, all domestic firms. The F-statistics and p-values from the Wald test of the joint coefficient restrictions and for the step-down coefficient restrictions are listed, for both OLS and GMM estimation. The p-value is the probability of not rejecting the null hypothesis, that the benchmark portfolio of all domestic firms spans the extended set of MNCs plus the benchmark portfolio. The Sharpe ratio of the benchmark portfolio and the extended set is listed both allowing and restricting short sales in each.

Table 9 MVS Tests and Sharpe Ratio Results for Optimally Weighted Portfolios

	Portfolio Description	*OLS*		*GMM*		*Sharpe ratio*	*% change*
		F-stat	p-value	F-stat	p-value		
	All domestics					0.24	
	Panel A: Test portfolios – Type 1: Fastest Internationalisers						
No Short Sales	> 50% Increase	10	0.01	7	0.02	0.48	100%
	>= change of 6 segments	31	0.00	12	0.00	0.53	121%
	>= change of 3 regions	38	0.00	10	0.00	0.58	141%
Short Sales	> 50% Increase	16	0.00	16	0.00	0.80	233%
	>= change of 6 segments	33	0.00	21	0.00	0.89	271%
	>= change of 3 regions	29	0.00	21	0.00	1.14	373%
	Panel B: Test portfolios – Type 2: Highest levels of internationalisation						
No Short Sales	> 50% Foreign Sales	20	0.00	17	0.00	0.60	150%
	>= 5 segments	3	0.04	7	0.02	0.58	142%
	>= 4 regions	11	0.00	8	0.00	0.62	158%
Short Sales	> 50% Foreign Sales	27	0.00	22	0.00	1.08	350%
	>= 5 segments	5	0.00	3	0.07	0.67	179%
	>= 4 regions	14	0.00	12	0.00	1.01	321%

Notes: This table shows F-statistics and p-values of the Wald tests for Mean-Variance Spanning for both OLS and GMM estimation. It also lists the Sharpe ratio increases when portfolio of MNCs with optimised weights are added to a portfolio of domestic firms. In Panel A, weights of MNCs with the greatest increases in internationalisation are optimised, firstly restricting and then allowing short sales. In Panel B weights of MNC which are consistently the most international are optimised with and without short sales.

Appendix

To derive the form of the mean variance spanning test that we use in the next section, we rewrite equation (4) in matrix notation as

$$R = X\beta + \sum \qquad \text{(A.1)}$$

with the unconstrained maximum likelihood estimates of β and Σ being determined as usual by

$$\hat{\beta} = \left(X'X\right)^{-1}\left(X'R\right) \text{ and } \hat{\Sigma} = \frac{1}{T}\left(R - X\hat{\beta}\right)'\left(R - X\hat{\beta}\right)$$

To derive the tests of spanning and to facilitate their geometric presentation, we define $\hat{\mu} = \sum_{t=1}^{T} R_t / T$ and $\hat{V} = \sum_{t=1}^{T}\left(R_t - \hat{\mu}\right)\left(R_t - \hat{\mu}\right)'$, and we define three constants *a*, *b*, *c* and *d* that are important determinants of the location and shape of the efficient frontier. We do this for the efficient frontiers with *K* and with *K+N* assets. For *K* assets, we have $\hat{a}_K = \hat{\mu}_K' \hat{V}_{11}^{-1} \hat{\mu}_K$, $\hat{b}_K = \hat{\mu}_K' \hat{V}_{11}^{-1} 1_K$, $\hat{c}_K = \hat{1}_K' \hat{V}_{11}^{-1} 1_K$ and $\hat{d}_K = \hat{a}_K \hat{c}_K - \hat{b}_K^2$. The equivalent for *K+N* assets is $\hat{a}_{K+N} = \hat{\mu}_{K+N}' \hat{V}^{-1} \hat{\mu}_{K+N}$, $\hat{b}_{K+N} = \hat{\mu}_{K+N}' \hat{V}^{-1} 1_{K+N}$, $\hat{c}_{K+N} = \hat{1}_{K+N}' \hat{V}^{-1} 1_{K+N}$ and $\hat{d}_{K+N} = \hat{a}_{K+N}\hat{c}_{K+N} - \hat{b}_{K+N}^2$. As we move from the frontier with *K* benchmark assets to the more general frontier with *K+N* assets, these constants will change by $\Delta\hat{a} = \hat{a}_{K+N} - \hat{a}_K$, $\Delta\hat{b} = \hat{b}_{K+N} - \hat{b}_K$ and $\Delta\hat{c} = \hat{c}_{K+N} - \hat{c}_K$. We can now form the following two matrices, the latter of which is termed the marginal information matrix (see Jobson and Korkie (1989)).

$$\hat{G} = \begin{vmatrix} 1 + \hat{a}_K & \hat{b}_K \\ \hat{b}_K & \hat{c}_K \end{vmatrix} \text{ and } \hat{H} = \begin{vmatrix} \Delta\hat{a} & \Delta\hat{b} \\ \Delta\hat{b} & \Delta\hat{c} \end{vmatrix} \qquad \text{(A.2)}$$

Combining the $\hat{G}$ and $\hat{H}$ matrices in (A.2), recalling that $\hat{\Sigma}$ denotes the unconstrained (with *K+N* assets) maximum likelihood estimate of Σ in (A.1), denoting the constrained (with *K* assets) maximum likelihood estimate of Σ in (A.1) as $\tilde{\Sigma}$, and letting $U = \left|\hat{\Sigma}\tilde{\Sigma}^{-1}\right|$, the likelihood ratio test of whether the *K* benchmark assets span the *K+N* benchmark and test assets is:

$$LR = -T\ln(U) \tag{A.3}$$

where

$$U = \left|\hat{\Sigma}\tilde{\Sigma}^{-1}\right| = \frac{\left|\hat{G}\right|}{\left|\hat{G}+\hat{H}\right|} = \frac{(1+\hat{a}_K)\hat{c}_K - \hat{b}_K^2}{(1+\hat{a}_{K+N})\hat{c}_{K+N} - \hat{b}_{K+N}^2} = \left(\frac{\hat{c}_K}{\hat{c}_{K+N}}\right)\left(\frac{1+\frac{\hat{d}_K}{\hat{c}_K}}{1+\frac{\hat{d}_{K+N}}{\hat{c}_{K+N}}}\right)$$

Huberman and Kendel (1987) and Jobson and Korkie (1989) show that the distribution of the likelihood ratio test under the null is distributed as

$$F = \left(\frac{T-K-N}{N}\right)\left(U^{-\frac{1}{2}}-1\right) = \left(\frac{T-K-N}{N}\right)\left[\left(\frac{\sqrt{\hat{c}_{K+N}}}{\sqrt{\hat{c}_K}}\right)\left(\frac{\sqrt{1+\frac{\hat{d}_{K+N}}{\hat{c}_{K+N}}}}{\sqrt{1+\frac{\hat{d}_K}{\hat{c}_K}}}\right)-1\right] \tag{A.4}$$

We know that the standard deviations of the minimum variance portfolios of the *K* benchmark assets and the *K+N* benchmark and test assets are $1/\sqrt{\hat{c}_K}$ and $1/\sqrt{\hat{c}_{K+N}}$, so the first ratio on the right hand side of (8) is their ratio, which is always greater than one. Kan and Zhou (2001) also show that the second ratio is the length of the asymptote from to the *K+N* efficient frontier benchmark divided by its equivalent to the restricted frontier of the *K* benchmark assets, and this ratio is also greater than one. Diagrammatically, Kan and Zhou (2001) show that the likelihood ratio test, the Wald test and the Lagrange multiplier test are closely related tests of mean variance spanning as shown in Figure 1in the text.

In our tests, we focus on the Wald test for the case of *N = 1*. Kan and Zhou (2001) show that although the power of the three spanning tests is difficult to gauge when *N > 1*, the likelihood ratio test is generally not the most powerful. They also show that for the case of *N = 1*, differences in the minimum variance portfolio are more important that differences in the tangent portfolio, and the Wald test is the most powerful of the three. We estimate equation (3) using OLS and the *2n* restrictions in equation (4) in the text are tested using a Wald test. The distribution of the asymptotic Wald test statistic of the null hypothesis is:

$$W = T(\lambda_1 + \lambda_2) \sim \chi^2_{2n} \tag{A.5}$$

Kan and Zhou (2001) outline a procedure whereby mean-variance spanning tests can be decomposed into two parts: the spanning of the global minimum-variance portfolio and the spanning of the tangency portfolio. In this case, we can re-write the Wald test statistic as:

$$W = T\left(\frac{\left(\hat{\sigma}_{R_1}\right)^2}{\left(\hat{\sigma}_R\right)^2} - 1\right) + T\left(\frac{1+\hat{\theta}_R\left(R_1^{GMV}\right)^2}{1+\hat{\theta}_{R_1}\left(R_1^{GMV}\right)^2} - 1\right) \tag{A.6}$$

where $(\hat{\sigma}_{R1})^2$ and $(\hat{\sigma}_R)^2$ are the global minimum-variance of the benchmark assets and benchmark plus the extended assets respectively. $\hat{\theta}_{R1}(R_1^{GMV})$ is the slope of the asymptote of the mean-variance frontier for the benchmark assets, and $\hat{\theta}_R(R_1^{GMV})$ is the slope of the tangency line of the mean-variance frontier for the benchmark portfolio plus the extended set (based on the return of global minimum-variance portfolio for the benchmark assets, R_1^{GMV}). The first term measures the change of the global minimum-variance portfolios due to the addition of the new asset. The second term measures whether there is an improvement of the squared tangency slope when the extended set of assets is added to the benchmark asset.

Kan and Zhou (2001) show that the asymptotic tests have very good power for test assets that can reduce the variance of the global minimum-variance portfolio, but have little power against test assets that can only improve the tangency portfolio. They therefore suggest a step-down procedure, whereby they first test $\alpha = 0_n$ and then test $\delta = 0_n$ conditional on $\alpha = 0_n$. The step-down asymptotic Wald tests can then be written as:

$$\begin{aligned} W_1 &= T(\lambda_3) \sim \chi^2_n, \\ W_2 &= T(\lambda_4) \sim \chi^2_n \end{aligned} \tag{A.7}$$

If we reject the hypothesis due to the first test, the tangency portfolios are different, and if we reject due to the second test, the global minimum-variance portfolios are very different.

The OLS tests above assume the error terms are normally distributed and homoskedastic. In order to test the robustness of this assumption, we also perform all tests using the Generalised Method of

Moments (GMM) approach. The GMM approach has the advantage that it does not require information on the exact distribution of the error terms. We use the following GMM Wald test:

$$W_a = T \times vec\left(\hat{\Theta}^{'}\right)^{'}\left[\left(A_T \otimes I_N\right)S_T\left(A_T^{'} \otimes I_N\right)\right]^{-1} vec\left(\hat{\Theta}^{'}\right) \sim \chi^2_{2N} \tag{A.8}$$

where the moment condition is

$$E\left[g_t\right] = E\left(X \otimes E\right) = 0_{n(1+k)}^{'} \tag{A.9}$$

$$S_T = E\left[g_t^{'} g_t\right] \tag{A.10}$$

$$A_T = \begin{bmatrix} 1+\hat{a}_1 & -\hat{\mu}_1^{'}\hat{V}_{11}^{-1} \\ \hat{b}_1 & -1_k^{'}\hat{V}_{11}^{-1} \end{bmatrix} \tag{A.11}$$

We also conduct step-down GMM Wald tests to disentangle the two sources of spanning. The step-down GMM Wald test statistics are distributed as chi-square with N degrees of freedom.

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Endnotes

[1] The eclectic OLI (ownership-location-internalisation) paradigm of Dunning (1977, 1980, 1988, 2000) combines the insights of industrial organisation, international trade and market imperfections theories to explain the internationalisation process as governed by three general factors; the ownership advantages of the firm (O), the location advantages of the market (L), and the internalisation advantages of conducting transactions within the firm rather than on open markets (I).

[2] The Uppsala IPT model predicts that firms internationalise incrementally through a learning process. At the early stages, they have little knowledge or experience, so they enter markets that are close to their home base (in terms of geographic, legal, cultural, or other economic measures of distance) because the costs, uncertainties and risks are lowest there, and they further internationalise over time.

[3] The new venture internationalisation theory (NVIT) of McDougall, Shane and Oviatt (1994), Barkema and Vermuelen (1997) and Oviatt and McDougall (1997) describes an INV as a firm that seeks competitive advantage from its resources and outputs in many countries from inception, and several studies (Knight and Cavusgil, 1996; and Knight, Bell and McNaughton, 2001) confirm their pattern of rapid globalisation.

[4] Consider the following two firms, the technology firm, Lam Research rapidly internationalised from 22% foreign sales in 1996 to 91% foreign sales in 2011, whereas the human resources company, Manpower Group, consistently had sales in at least 4 of the 6 regions of the world in every year of our 15 year period.

[5] For our measures of internationalisation we only use sales data to categorise firm internationalisation. Berrill (2009) categorises each firm on the *Fortune 500 List* in 2005 using other accounting variables listed by geographic segment in the Form 10-K; assets, operating income, capital expenditure and depreciation. Her results show that in most cases, firms list the same geographic segments for each of the five variables. Therefore we conclude that adding further accounting variables to sales data would add little to the analysis.

[6] Following the system used by Aggarwal et al. (2011), some firms use classifications such as EMEA (Europe, Middle-East and Africa), which we classify as three regions, or Asia-Pacific which we classify as two. Many firms also create a category such as 'Other foreign' to include all remaining items after the most significant areas have been detailed in the accounts. When this occurs, we add one region.

[7] The relevant accounting standard for geographical segment disclosure IFRS 8 replaced IAS 14 in 2006. It does not specify a quantitative threshold for 'material' sales or assets, it is assumed to be between 5 and 10 per cent. Firms must disclose a segment that accounts for over 10% of its total assets, profit or revenue.

[8] Apache Corp Annual Report 2013.

[9] archive.fortune.com.

[10] www.bloomberg.com.

[11] We selected the highest possible thresholds for each measure of internationalisation while ensuring sufficient firms in each portfolio.